

STUDIES IN MALESIAN PANDANACEAE, 19.
NEW SPECIES OF FREYCINETIA AND PANDANUS
FROM MALESIA AND SOUTHEAST ASIA

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DURING A STUDY VISIT of several months in the Harvard University Herbaria made possible through the courtesy of the Director of the Arnold Arboretum, several new taxa of *Freycinetia* and *Pandanus* were recognized. Their descriptions, presented here, form a part of the background necessary for the treatment of the Pandanaceae in *Flora Malesiana*, which is in preparation. I am grateful to the curators of the various herbaria listed herein for making these materials available for study.

Freycinetia Gaudich.

Sect. BLUMEELLA Stone

Freycinetia impudens B. C. Stone, sp. nov.

Liana modice robusta caulis foliosis usque ad 15 mm diametro. Folia coriacea usque ad 60–90 × 2.5–4 cm, lineari-lanceolata, sensim attenuato-acuminata, marginibus in basi breve tractu spinuloso-denticulatis, et apicem versus manifeste denticulatis (denticulis vix 1 mm longis, acicularibus, 2–5 mm sese separatis); costa media infra breviter carinato, basi inerme, apicem versus spinuloso-denticulata; pagina adaxiale minute obscureque striatula, abaxiale crebre venoso-striatula et subevidenter tessellata, reticulationibus ca. 2–3 × 0.4 mm, minutissime per stomata punctulatis; auriculis 7–12 × 8–11 cm, subrigide membranaceis, in sicco pallide brunneis, apice incurvato-subtruncatis, deinde persparse ciliato-denticulatis, margine integris. Inflorescentia terminalis, plerumque ternata; bracteis exterioribus foliaceis usque ad 35 cm longis, basi coloratis, carnosis, expansis; bracteis interioribus naviculari-deltoideis apice abrupte angustato-foliaceis, usque ad 15 cm longis, basi ca. 8 cm lato. Cephalia cylindracea, pedunculis usque ad 5 cm longis et 6 mm diametro, glabris (vel distaliter sparse minuteque hispidulis); cephalia immatura ca. 6–8 × 16 mm, carpidiis plerumque 2–4-natis, ca. 5 × 1 mm, pileo probabiliter 2.5 mm longo, vertice truncato, stigmatibus 2–4(–6) confluentibus, annulo angusto cincto. Spadix masculus ca. 12 cm longus, pedunculo glabro 5–7 cm longo et ca. 5 mm diametro, parte florifero ca. 7 cm longo et usque ad 9 mm diametro, staminibus congestis ca. 2–2.5 mm longis, filamentis 1.5–2 mm longis, antheris breve-oblongis ca. 0.8–1 mm longis obtusis. Cephalium bisexuale in specimine singulo (*Docters van Leeuwen 9986*) visum: carpidia et stamina intermixta,

filamentis staminorum 3.5–4 mm longis, antheris ut videtur normalibus, staminibus carpidium aequantibus vel leviter superantibus.

TYPE. New Guinea, Papua, Fly River 30 mi above D'Albertis junction, Oroville Camp, in rainforest, Aug. 1936, *L. J. Brass* 7426 (holotype, A!).

ADDITIONAL SPECIMENS EXAMINED. **New Guinea.** IRIAN BARAT: Rouffaer R., 175 m alt., forested hills, *W. M. Docters van Leeuwen* 9986 (BO!, L!); between Hollandia and Hollandia-Binnen, 80 m alt., secondary forest, *BW* 3612, *C. Kalkman* (L!).

Brass 7426 is one of the two specimens tentatively identified by Merrill and Perry as *Freycinetia pseudo-insignis* Warb. They remarked (*J. Arnold Arb.* 20: 158. 1939): "Somewhat hesitantly we add here the following collection: *Brass* 7426. . . . This differs from the other collections in its obviously narrower leaves. The anthers of the ♂ inflorescence are about 3 mm. long [*sic*]." Martelli and Merrill and Perry have all mingled two species under the name *F. pseudo-insignis*; at least one of them (that now named above as *F. impudens*) and possibly the other cannot be equated with Warburg's species. Warburg's protolog calls for staminate spadices 8 cm long, the floriferous part 4 cm by 7 mm, and filaments 1.5 mm long. In *F. impudens* the spadices are about this size but the stamens are longer. Another very similar species is *F. inouei* Kanehira, also described from Irian Barat. Merrill and Perry thought this species to be the same as their *F. archboldiana*, and the two do belong together in Sect. BLUMEELLA. However, since the inflorescence in *F. inouei* appears to be regularly ternate (rather than multicephalic, as is the norm in *F. archboldiana*), it seems better to keep them distinct. On the other hand, it is possible that *F. inouei*, which was typified by a pistillate specimen, is the same taxon as *F. pseudo-insignis*, which was typified by a staminate one. In any case, *F. inouei* differs from *F. impudens* by its somewhat narrower and shorter leaves with less acuminate apices, smaller leaf prickles, and shorter, narrower spadices. The berries of *F. inouei* are mostly bistigmatic, while those of *F. impudens* are more frequently 3- to 5-stigmatic.

It is interesting to note the occurrence of bisexual cephalia in this species, a phenomenon rarely seen but known to date in *Freycinetia imbricata* Blume (*Bünnemeijer* 5031, from Sumatra), *F. negrosensis* Merr. (*Stone* 12911, from the Philippines), *F. scabripes* Warb. (*PNH* 117425, *Gutierrez et al.*, from the Philippines), and *F. reineckeii* Warb. (*P. A. Cox*, several collections from Samoa). Only in the case of *F. reineckeii*, however, is it known that both the male and the female organs in the cephalium are functional. Cox (pers. comm.) suggests that such bisexuality is an adaptive response to promote fertilization through bat pollination, since the bats are more attracted to polliniferous than to pistillate cephalia.

Sect. DEVRIESEELLA Stone

Freycinetia micrura B. C. Stone, sp. nov.

FIGURE 1.

Liana habitu valde similis *Freycinetia sphaerocephalo* Gaudich. sed pedunculo foemineo densiter hispidulo, foliis parce angustioribus differt. Folia parva 7–10 cm × 4–7 mm, anguste elliptico-suboblanceolata, apice basinque angustata, apice sensim attenuato-caudato in caudo ca. 15–20 mm longo desinentio;

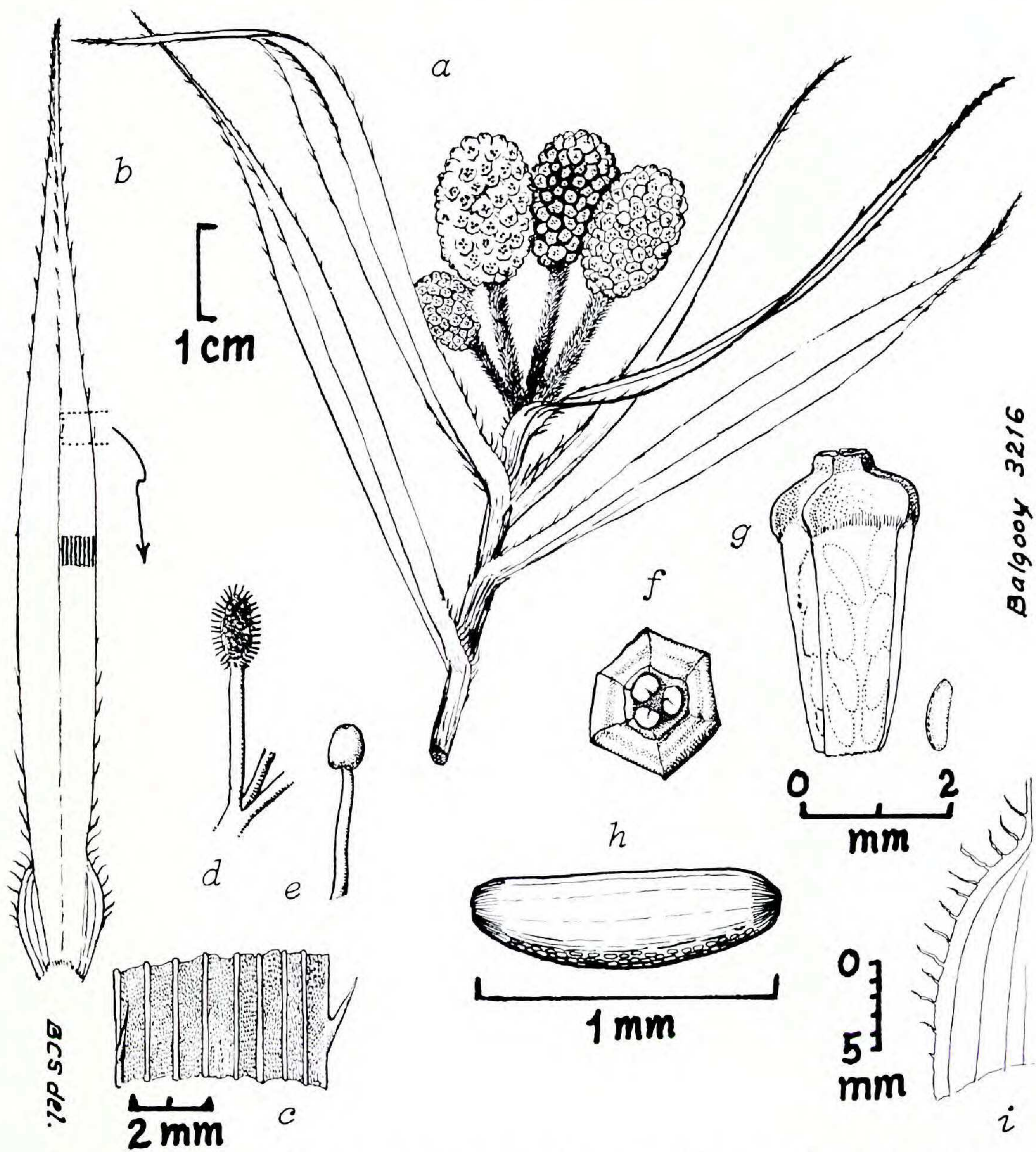


FIGURE 1. *Freycinetia micrura* (from *Van Balgooy 3216*, type collection): a, habit of fruiting branchlet; b, leaf, abaxial surface; c, portion of leaf margin, showing veins and marginal prickles; d, staminate spike; e, stamen, enlarged; f, berry, top view, showing 3 stigmas; g, berry, side view, seed beside it; h, seed, enlarged; i, auricle of leaf base, showing spinular margin.

vagina appresso, auriculis 12–14 × 2–3 mm, apice curvatis, marginibus spinuloso-pectinatis, spinulis angustis subrectis 0.8–1.8(–2) mm longis; lamina foliorum marginibus basi apiceque spinulosis (parte medio tertio inerme) vel, in foliis parvioribus, e basi ad apicem spinulosis; spinulis antrorsis vulgo 1 mm longis, apicem versus brevioribus (ca. 0.5 mm longis); costa media in parte dimidia distali spinulosis, spinulis ad eos in margine adjacentio similis, vulgo 1–2 mm sese separatis. Inflorescentia terminalis, ternata (vel quaternata), bracteis late ovatis, usque ad 30 × 15 mm, plus minusve caudatis, marginibus minute serrulato-spinulosis; pedunculo foemineo usque ad 20 mm longo, 2–

2.5 mm crasso, subcompresso, densiter hispidulo e basi ad apicem spinulis subappressis congestis 0.5 mm longis; cephalio ellipsoideo-subgloboso (ubi immaturo ca. 17×10 mm); gynoecio breve $4-5 \times 1.5-2$ mm, apice ca. 1 mm alto, late pyramidato-rotundato, areola centrali bi- vel quinque-stigmatifero ca. 1-1.4 mm lato instructo; seminibus immaturis ca. 1 mm longis. Cephalia mascula ca. 8-9 mm longae, pedunculo masculino laevi, glabro, ca. 15 mm longo; staminibus vix numerosis, filamentis 1.75 mm longis, antheris subgloboso-oblongis ca. 0.5 mm longis.

TYPE. Sulawesi, Mt. Roroka Timbu, western slope at 2000 m alt., in montane forest dominated by *Agathis* 40 m tall; climber with green fruit, bracts white, purple tipped; May 1979, *M. J. van Balgooy* 3216 (holotype, L!).

A very distinct little plant evidently related to *Freycinetia sphaerocephala* Gaudich. of the Philippines, but differing markedly in the very densely hispidulous peduncles of the pistillate cephalia, and in the narrower leaves; the spinules of the leaf and auricle margins may be up to 2 mm long. The fruit described is unfortunately not yet mature.

I am grateful to Dr. van Balgooy for his kindness in allowing me to study the materials he collected, in advance of their distribution.

Pandanus L. ex Stickman

Sect. ACROSTIGMA Kurz

Pandanus ketele B. C. Stone, sp. nov.

FIGURE 2.

Frutex gracilis, stipite erecto usque ad 3 m alto, 2-5 cm diametro, laevi, radicibus aereis basalibus, parvis, brevibus. Folia ca. $160 \times 3.7-4.1$ cm elongato-linearia, apice acutata, supra nitidam viridem, infra subglaucam, nervis longitudinalibus ca. 100 per foliam congestis; marginibus in basi (parte vaginanti ca. 7 cm longo excepto) spinuloso-denticulatis, denticulis patento-antrorsis curvatis usque ad 2 mm longis, 2-6 mm sese separatis, in medio, denticulis appressiter antrorsis, ca. 0.5 mm longis, 2-4 mm sese separatis, apicem versus, denticulis ca. 0.2 mm longis, ca. 1 mm sese separatis; costa media infra in basi denticulis unguiculiformibus usque ad 3 mm longis et 5-9 mm sese separatis, in medio denticulis parvis vel costa inerme carinata, deinde denticulis parvis vix 0.4 mm longis, 5-15 mm sese separatis, apicem versus denticulis parvissimis vix 0.2 mm longis, ca. 1 mm sese separatis; plicis binis apicali-ventralibus in parte distale ca. 30 cm longo denticulatis, denticulis antrorsis parvis subirregulariter dispersis. Inflorescentia lateralis, gracilis, suberecta, ca. 64 cm longa, 14 mm diametro, parte distali fertili ca. 12 cm longo, capitulis congestis vulgo 7 aggregatis, parvis, ovato-subglobosis, subplano-convexis, 3.5-4.5 cm longis, subequidiametralibus, aurantiaco-rubris, e pluribus drupis compositis. Drupa ca. 2 cm longa (stylo incluso), pileo ca. 8 mm longo, 3 mm crasso, subacuto, in stylo spiniformi antrorse curvato 5-6 mm longo producto; parte seminifero ca. 8 mm longo.

TYPE. Papua New Guinea, Southern Highlands Province, Tari valley, Itipu village, ca. 1640 m alt., in swampy areas with secondary growth, Sept. 1981, *B. C. Stone & C. Rose* 15005 (holotype, KLU!).

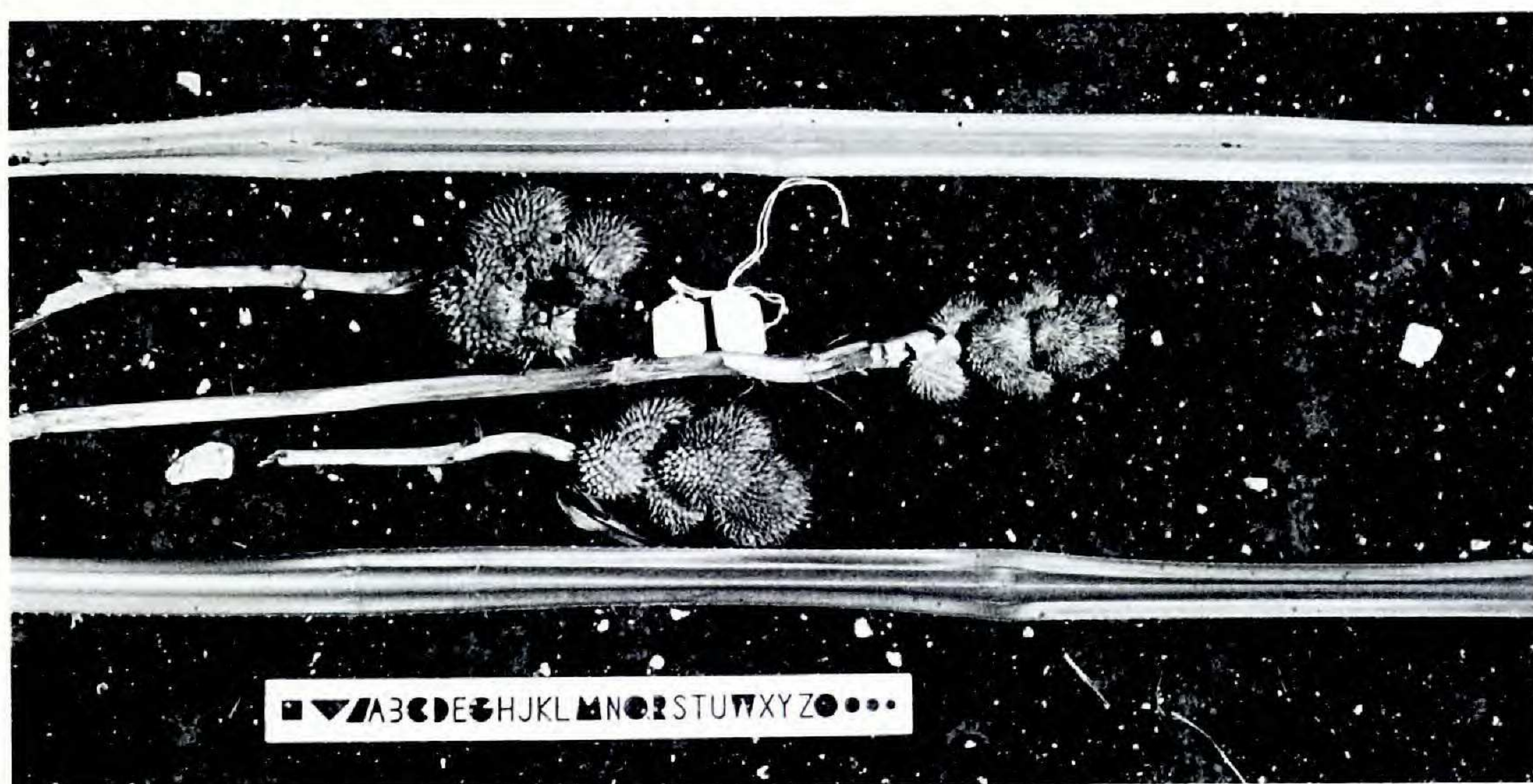


FIGURE 2. *Pandanus ketele*: leaves and infructescences of Stone & Rose 15005 (type collection) photographed in the field. Ruler is 30 cm long.

This species clearly belongs with *Pandanus adinobotrys* Merr. & Perry, *P. setistylus* Warb., *P. angiensis* Kanehira, and *P. pseudosyncarpus* Kanehira, all of New Guinea (including Irian Barat), but differs from all of them in its much narrower leaves and its very long pistillate peduncle bearing small, crowded cephalia. Like these species it is characterized by lateral inflorescences—i.e., axillary fertile shoots that bear scale leaves (and occasionally some reduced foliage leaves) and floral bracts—that are clearly differentiated in function from the strictly foliage-bearing leaf crowns. All these species occur in the interior and mainly at intermediate altitudes, usually between 600 and 1800 m. *Pandanus ketele* occurs in small swamps and is sometimes cultivated as a hedge plant. The ripe drupes are dull vermilion, as is true for most (perhaps all) of the above-mentioned related species.

The collectors thank the children of Itipu village for help in collecting the material.

***Pandanus lustrorum* B. C. Stone, sp. nov.**

FIGURE 3.

Frutex erectus, stipite usque ad 4 m alto, ramis fertilibus lateralibus brevissimis, foliaceis. Folia anguste lineares acutissima usque ad 107×2 cm, in ramis fertilibus breviora, rigide coriacea, basi in vaginam brevem expansa; vagini ca. 2.5 cm longo striatulo-venoso; laminis obscure longitudinaliter venosis; marginibus in basi dentibus patenti-antrorsis ca. 2 mm longis, 1.5–8 mm sese separatis, in medio dentibus valde appressis vel antrorsis 0.6–1 mm longis, 4–8 mm sese separatis, apicem versus denticulis 0.4–0.7 mm longis, 0.5–0.9 mm sese separatis; costa media infra in basi dentibus reflexis usque ad 4 mm longis, 3–9 mm sese separatis, in medio denticulis antrorsis vix 1 mm longis, 3–10 mm sese separatis, apicem versus denticulis brevioribus denticulis marginorum similibus; plicis binis apicalibus denticulatis. Inflorescentia terminalis, pedunculo 30–35 cm longo, 5–6 mm diametro (in sicco), bracteato, distaliter infra cephalia modice sinuato; bracteis non vidi, delapsis. Cephalium ovoideum, 5.2

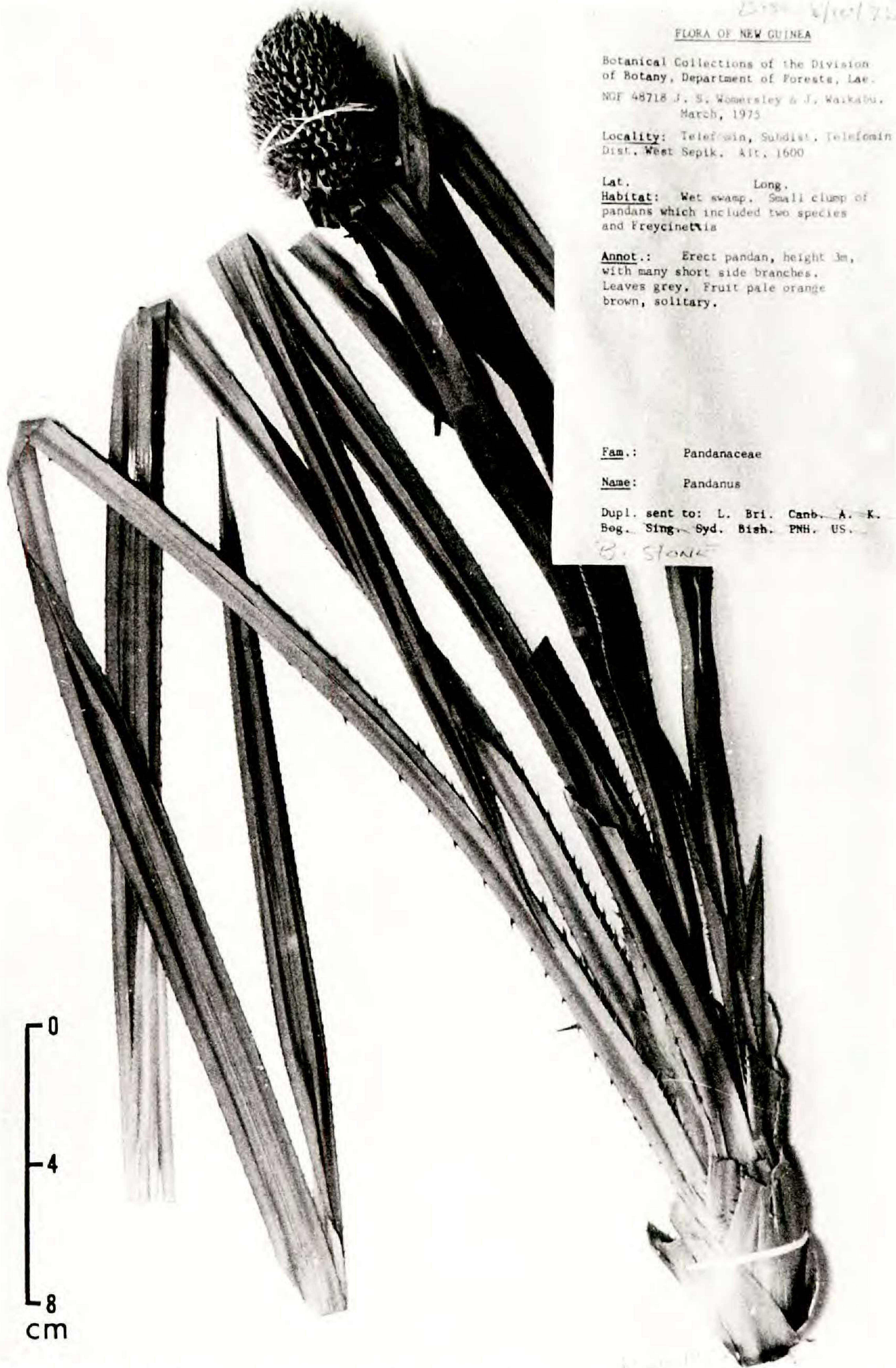


FIGURE 3. *Pandanus lustrorum* (NGF 48718): isotype in LAE with monocephalic infructescence.

× 4.8 cm, ca. 600 ad 800 drupis compositum, aurantiaco-brunneum; drupis angustis subfusiformibus, 13–19 mm longis (stylo incluso), parte basilari 6–8(–9) mm longo, pileo acutissime conico-pyramidato 5–7 mm longo apice in stylo antrorse deflecto spiniformi 4 mm longo producto. Mesocarpium superum meduloso-fibrosus, inferum fibrosus brevissimum. Endocarpium ca. 7 mm longum in parte dimidio basali situatum anguste obconicum, pariete ca. 0.15 mm crasso. Cetera ignota.

TYPE. Papua New Guinea, West Sepik Province, Telefomin, 1600 m alt., erect pandan in wet swamp, March 1975, *NGF 48718*, *Womersley & Waikabu* (holotype, KLU!; isotypes, BRI, L, LAE).

ADDITIONAL SPECIMENS EXAMINED. **New Guinea.** PAPUA NEW GUINEA. West Sepik Province: Telefomin, 1600 m alt., wet swamp, *NGF 48716*, *Womersley & Waikabu* (KLU, LAE), *NGF 20829*, *Henty* (LAE!).

This species is very much like *Pandanus adinobotrys*, and previously the above-mentioned specimens were assigned to that species. However, the specimens differ in their narrower leaves, often solitary fruit-head, and shorter styles, and they therefore appear to represent a somewhat cryptic species. This species, together with *P. ketele* (described above), forms an addition to the cluster of New Guinea species centered around *P. setistylus*. The limits of variation within members of this group are still not very well understood, and further field study of them is desirable.

Sect. MARKGRAVIDENDRON Huynh & Stone

Pandanus sulawesicus B. C. Stone, sp. nov.

FIGURE 4.

Arbor, stipite in basi radicibus aereis rigidis emittens. Folia lineari-loriformia, apice abrupte acuminato breve-caudata, basi sensim angustata, profunde canaliculato; marginibus in basi spinulosis, spinulis curvato-patentibus curvatis acutis, ca. 4 mm longis, rariter duplicatis, 2–5 mm sese separatis, in medio cum spinulis 2.5 mm longis, 7–9 mm sese separatis, apicem versus spinulis ca. 1 mm longis, 0.6–3 mm (vel usque ad 12 mm) sese separatis; costa media in basi spinulis reflexis vel recurvatis ca. 4 mm longis, 2–5 mm sese separatis, in medio inermis, profunde et acute carinata, vel sparse et irregulariter paucispinulosa, spinulis antrorsis, apicem versus, spinulis antrorsis ca. 1 mm longis, confertioribus, ca. 4–5 mm sese separatis, in cauda densiter congestis, vix 1 mm sese separatis; nervis longitudinalibus ca. 0.75–0.9 mm sese separatis, infra leniter prominulis, ca. 86 per foliam (costa media excluso), apicem versus cum venulis transversis ca. 2–3 mm remotis connectis. Inflorescentia foeminea pedunculata; cephalium solitarium, oblongo-cylindraceum, ca. 19 × 9 cm, plurimis drupis compositum. Drupa irregulariter cuneata, apice truncato, (33–) 36–40 mm longa, pileo indistincto integri, quinque- vel sexangulato, ca. 15 mm lato, vertice plano vel subdepresso, stylo perbreve ad latum areolis verticis posito, sursum spectantio; stigma ca. 3 × 3 mm, oblique vel verticaliter situato, aperturo centrali, margine minute denticulato, denticulis superioribus 3 vel 5, inferioribus 5 vel 8. Mesocarpium apicale ca. 8 mm longum cavernosum; basale

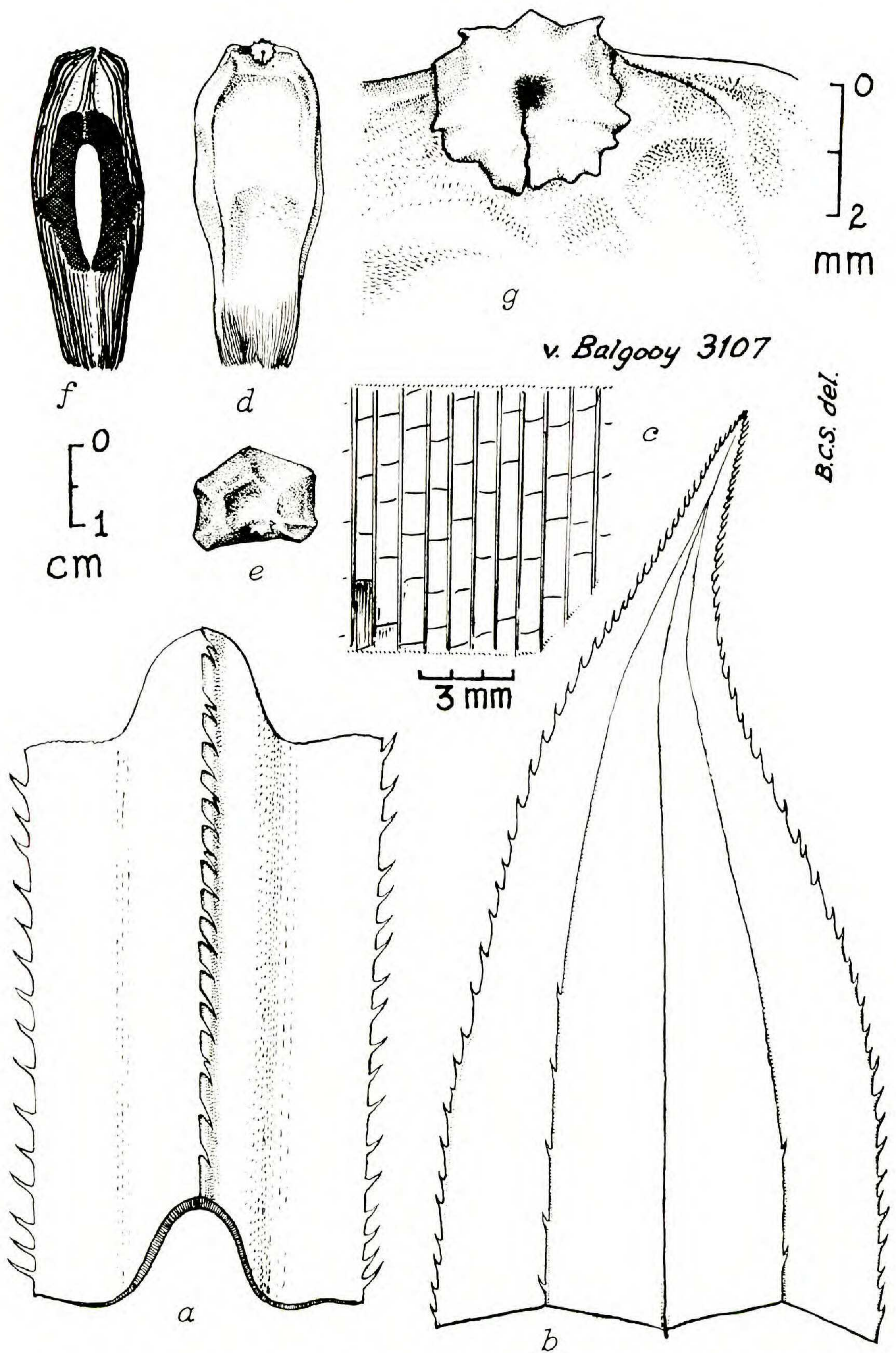


FIGURE 4. *Pandanus sulawesicus* (from *Van Balgooy 3107*, type collection). a–c, leaf: a, base, abaxial surface; b, apex, adaxial surface; c, detail of venation, showing transverse commissures. d–f, drupe: d, side view; e, top view; f, longitudinal section. g, stigma, enlarged, frontal view.

fibrosum ca. 12–15 mm longum. Endocarpium centrale ca. 20 mm longum uniloculatum apice rotundato basi truncato, pariete ca. 3 mm crasso parte medio toruloso 4–5 mm crasso excepto. Cetera ignota.

TYPE. Indonesia, Sulawesi, ca. lat. 1°S, long. 120°E, Sopus Valley, 85 km SSE of Palu, 1000 m alt., rainforest on flat, very wet alluvial soil; stilt-rooted pandan, fruit orange; May 1979, *Van Balgooy 3107* (holotype, L!).

This is the second member of sect. MARKGRAVIDENDRON, formerly a monotypic section consisting only of *Pandanus navicularis* Stone (endemic to New Ireland in the Bismarck Archipelago).

In its leaves, *Pandanus sulawesicus* is reminiscent of *P. cheilostigma* Stone and *P. brevistipes* Martelli, both of sect. CHEILOSTIGMA Stone, but the fruit characters are quite different. Sect. CHEILOSTIGMA is endemic to the Philippines.

Sect. RYKIA (DeVriese) Kurz

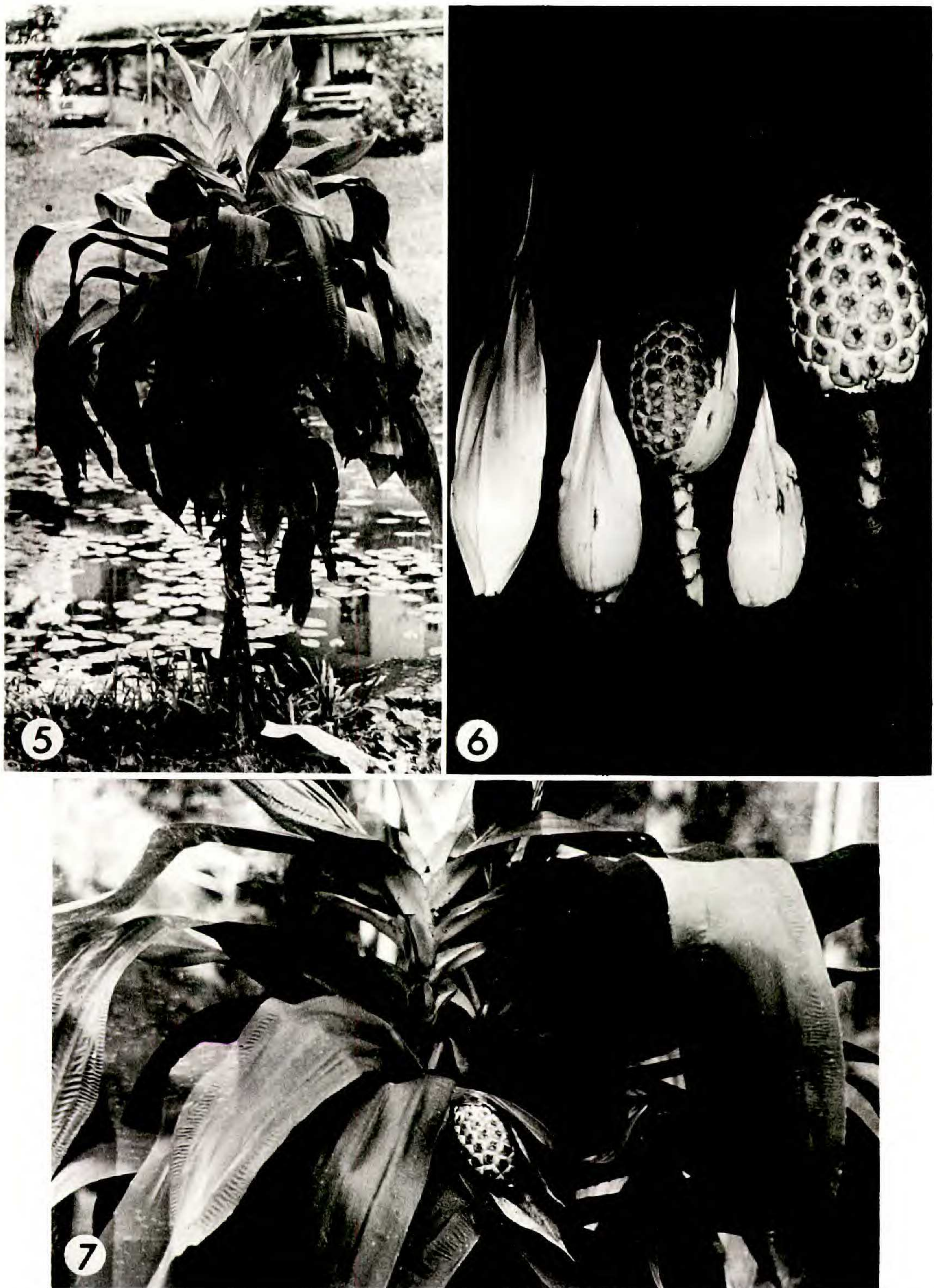
Pandanus albifrons B. C. Stone, sp. nov.

FIGURES 5–7.

Frutex simplex vel sparse ramosus usque ad 2–3.5 m altus, stipite angusti radicibus aereis paucibus brevibusque emittenti. Folia perлата, arcuata, usque ad 90–100 × 12–14 cm, acuminato-brevicaudata, basi conspicue angustata infra albo-glaucoscentia; vaginis auriculatis, auriculis usque ad 10–11 × 1 cm; marginibus in basi unguiculatis dentibus antrorsis patentibus curvatis ad 3–4 mm longis, 5–20 mm sese separatis, in parte medio dentibus remotissimis 1–2 mm longis, (20–)30–50(–60) mm sese separatis, depressiter antrorsis, in apice denticulis vix 1 mm longis, 1–5 mm sese separatis; costa infra in parte brevi basilari retrorse hamato-spinosa spinis 3–4 mm longis, 5–15 mm sese separatis, costa deinde pro maxima parte mediani apicem versus et caudem excepta exarmata obscure carinata, in apice denticulatis, denticulis antrorsis vix 1 mm longis, 2–4 mm sese separatis; pagina laminae utrinque apicem versus minute tessellata, nervis longitudinalibus ca. 100 ad 105 per foliam, venulis transversis ca. 0.6–0.7 mm sese separatis. Inflorescentia terminalis, pedunculo foemineo ca. 15 cm longo, 7 cm diametro, bracteatis, bracteis albidis exterioribus usque ad 23 × 6–7 cm, interioribus ovato-navicularibus breviter caudatis ca. 8 × 4 cm. Cephalium solitarium ellipsoideum e 90 ad 100 drupis compositum, ca. 12 × 7.7 cm, flavidum. Drupa obovoideo-cuneiforma ca. 25 × 14 × 11–12 mm, pileo depresso-pyramidato hexagonato, stylo brunneo, 4–5 mm longo, centrali, antrorse deflecto, 1- vel 2-cornulato, cornulis ca. 1–2 mm longis stigmatibus nigro. Pericarpium subcarnosum flavidum. Mesocarpium superum medullosa-fibrosum ca. 8–10 mm longum; inferum fibroso-carnosum ca. 5–7 mm longum. Endocarpium inverso-cupuliforme apice in prolongatione centrali erecti, basi leniter angustato, infra centro positum, ca. 8 mm longum (corno centrali excepta), atro-brunneum, pariete ca. 1 mm crasso. Cetera ignota.

TYPE. Malaysia, Kepong Forest Research Institute, plants introduced from Pasoh Forest Reserve (Negri Sembilan); fruiting; November 1978, *Stone & Ng 14003* (holotype, KLU!; isotypes, BISH, K, KEP, L, SING, US).

This handsome species belongs to the group including *Pandanus crinifolius*



FIGURES 5-7. *Pandanus albifrons*: 5, type tree; 6, bracts and 2 cephalia from type tree; 7, type tree with exposed cephalium (note new shoot with white leaf bases in upper center).

Martelli (Malaya), *P. leuconotus* Stone (Borneo), and *P. nervosus* Stone (Sumatra). It is most similar to *P. leuconotus*; both have remarkable white leaf undersurfaces that are particularly conspicuous at the base of the leaf. The new species differs from *P. crinifolius* in its whitish leaf-base undersurfaces, white or off-white floral bracts, less crispate blades, and longer styles; from *P. leuconotus* in its more abruptly rounded-acuminate leaf tips, white or off-white spathes, and broader laminae; from *P. nervosus* in its wider leaves, more ellipsoid cephalia, and whiter spathes; and from all these species in its very remote marginal prickles along the median part of the leaf.

Although clearly related to such other species as *Pandanus unguifer* Hooker f., *P. tonkinensis* Stone, *P. dictyotus* St. John ex Stone, and *P. huynhii* Stone, *P. albifrons* is distinguished by several characters, especially the very broad, loriform leaves with the undersurfaces white near the base and broad auricular basal margins, and the white (vs. pink or yellow) floral bracts. The staminate plants of *P. albifrons* are still unknown, but they should strongly resemble those of *P. leuconotus*, undoubtedly the most closely related species.

***Pandanus dictyotus* St. John ex Stone, sp. nov.**

Frutex humilis, habitu *Pandanus crinifolius* vel parviore. Folia lineari-loriformia, apice acuminata subabrupte caudata, basi leniter angustata; vaginis purpurascens; laminis ca. 80 × 6 cm, striatulo-nervosis, apicem versus evidenter tessellatis, cauda subulato-filiforma ca. 5 cm longa terminatis; marginibus in basi cum denticulis patentibus leniter arcuatis 2–3 mm longis, vulgo 10–25 mm sese separatis, in medio subinermis, apicem versus denticulis antrorse curvatis ca. 1 mm longis, 1–3 mm sese separatis; costa media dorso in basi paucidentulatis, denticulis retrorsis, 2–3 mm longis, deinde erectis, subinermis, in medio inermis, apicem versus denticulis eis in margine adjacentio similibus. Inflorescentia terminalis, brevis, pedunculo foemineo ca. 7.5 cm longo, 5 mm crasso, apice incrassato, bracteato, bracteis superioribus congestibus ovato-ellipticis brevicaudatis, marginibus minute serrulatis; cephalio subellipsoideo ca. 7 × 4.5 cm, drupis simplicibus composito; drupa ca. 18–20 mm longa, pileo hemispherico pyramidato, stylo centrali antrorse curvato, subulato, ca. 4 mm longo, 1- vel 2-cornato, cornulis brevibus vix 1 mm longis.

TYPE. Sarawak, Bako National Park, March 1961, *S 13017*, *Rashid b. Taggoi* (holotype, SAR!).

A small shrub of lowland forest. For taxonomic comments, see under *Pandanus albifrons*.

***Pandanus leuconotus* B. C. Stone, sp. nov.**

FIGURE 8.

Frutex; stipite erecto usque ad 2.5 m alto e basi radicibus brevibus paucibus emittenti. Folia late loriformia arcuata, basi modice attenuata ad apicem acuminato-caudata usque ad 120 × 9.5 cm, tessellato-reticulata (in sicco), infra in parte basilari conspicue glauco-alba, marginibus toto denticulatis, denticulis maximis ad 7 mm longis, antrorsis; costa infra in basi denticulis reflexis armata.

Inflorescentia terminalis, cephalio druparum breve oblongo 10–12.5 × 6–7 cm, obscure trigonato, drupis 25–30 × 9–11 mm, pileo truncato-pyramidato, stylo castaneo uni- vel rariter bicornato 4–5 mm longo antrorse valde deflecto, endocarpio 10 mm longo, pariete 1 mm crasso. Spadix masculus bracteata, spathis fertilibus 7 usque ad 35 cm longis, spicibus oblongis albis 5–7 × 1.5 cm, phalangibus staminorum umbellatis columnis 3–5 mm longis, filamentis ca. 1 mm longis, antheris 1–1.2 mm longis apiculatis, apiculo 0.9–1.1 mm longo.

TYPE. Borneo, Sabah, Ranau District, Poring, base of Mt. Kinabalu, 330 m alt., in forest near Hot Springs, April 1975, *B. C. Stone et al.* 12906 (holotype, KLU; isotypes, BISH, K, L, SAN).

ADDITIONAL SPECIMENS EXAMINED. **Borneo.** SABAH: Mt. Kinabalu, Dallas, ca. 900 m alt., *J. & M. S. Clemens* 27751 (UC!), *J. & M. S. Clemens* 26857 (A!, BO!); Mt. Kinabalu, 330 m alt., *Stone* 12905 (KLU).

This species is similar in overall appearance and many particulars to *Pandanus albifrons* (described above), of the Malay Peninsula, and shares the white coloration of the leaf-base undersurface with that species, which is manifestly its nearest relative. It is also related to *P. crinifolius* and, a little more distantly, to *P. tonkinensis* Stone. For further details, see the comments after *P. albifrons*.

Plants of *Pandanus leuconotus* have been brought by Kinabalu National Park workers from nearby places and planted in the Poring Hot Springs area, where they thrive, flowering and fruiting regularly.

***Pandanus nanofrutex* B. C. Stone, sp. nov.**

Frutex nanus. Corona foliorum compacta. Folia linearia angusta usque ad 95 × 2.8 cm, apice acuminato vel breve-caudato, basi leniter angustata; marginibus denticulatis, in basi denticulis 2–3 mm longis, 5–12 mm sese separatis, in medio denticulis ca. 1 mm longis, appressis, antrorsis, ca. 5–14 mm sese separatis, apicem versus denticulis 0.5–0.75 mm longis, vulgo 1–2 mm sese separatis; costa media basem versus denticulis retrorsis 2–3 mm longis, vulgo 10–20(–35) mm sese separatis, in medio (parte tertio folii) inermis, carinatis, apicem versus denticulis antrorsis 1 mm longis, 5 mm sese separatis, et in cauda vix 2 mm sese separatis; venis longitudinalibus angustis, prominulentibus, 0.5–0.6 mm sese separatis, ca. 50 per foliam; venulis transversalibus prominulentibus, reticulationes subisolateralibus formantibus, areolis vix 1 mm longis. Inflorescentia terminalis, erecta, cephalio solitario oblato-globoso ca. 60 × 50–55 mm, pedunculo ad 14 cm longo angusto, apicem versus incrassato 7 mm crasso; bracteis usque ad 12 × 4 cm, abrupte acuminato-subcaudatis, apicem versus in margine costaque minute spinulosis; receptaculo ca. 20 × 20 mm. Drupae ca. 85 ad 95 per cephalio, 18–22 mm longae stylo excluso (ad 27 mm longo stylo incluso), 10–12 mm latae; pileo subhemispherico-pyramidale, 3–5 mm alto; stylo centrali, erecto vel antrorse deflecto, haud vel minime furcato, subtereti vel compresso, 5–6 mm longo, deltoideo-acuto, furcis ca. 1 mm longis; stigmatibus ca. 4 mm longo, ovato-elliptico. Mesocarpium superum medullosum, inferum fibrosum subcarnosum. Endocarpium central-

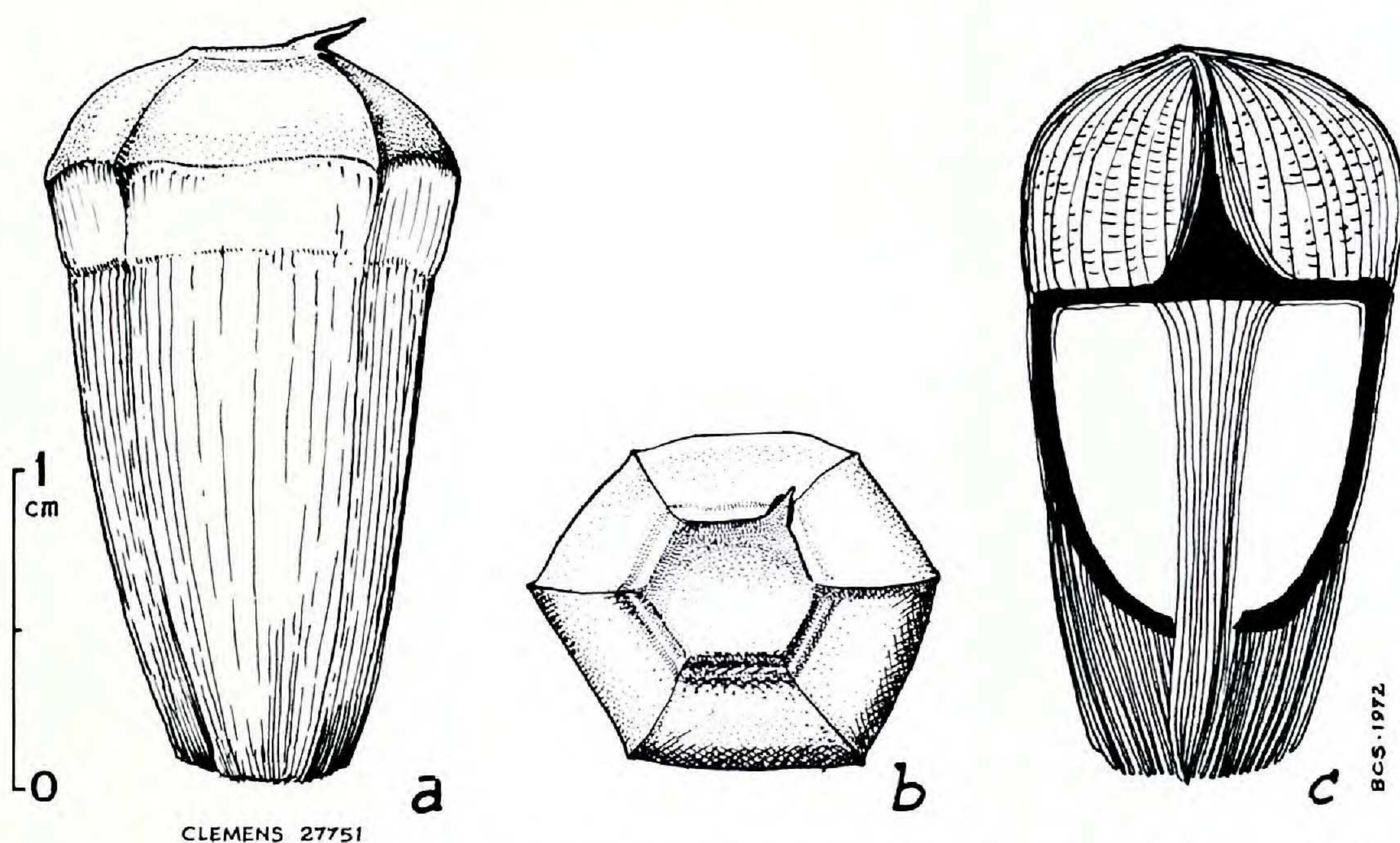


FIGURE 8. *Pandanus leuconotus* (from *Clemens 27751*), drupe: a, side view; b, top view; c, longitudinal section.

ium ca. 8 mm longum, apice conico-elongato, atrobrunneum, osseum, pariete ca. 1 mm crasso, loculo singulo.

TYPE. Tonkin [Vietnam, Hà Son Binh Province], Mt. Ba Vi, vallée du Lankok, dans les forêts, Janvier 1889, *Balansa 4165-bis* (holotype, P!).

This species stands out among the members of sect. RYKIA because of its dwarf, shrubby stature, its narrow leaves with large marginal prickles, and its small fruit-heads. Martelli had determined the type specimen previously as *Pandanus stenophyllus* Kurz (= *P. nitidus* (Miq.) Kurz), a Javanese species of sect. ASTERODONTIA Stone and not very closely related. Instead, *P. nanofrutex* belongs to a small group of species within sect. RYKIA that includes *P. unguifer*, *P. bicornis* Ridley, *P. huyhnii*, and some others that occur in southeastern Asia and western Malesia. It is quite similar to *P. bifidus* St. John, of Thailand, but differs in its smaller cephalia and drupes, its shorter style-forks, and its considerably shorter leaves.

***Pandanus nervosus* B. C. Stone, sp. nov.**

Frutex. Folia usque ad 100 × 11 cm, versus apicem perabrupte rotundata, apice acuminato-caudata, caudis ca. 9 cm longis; marginibus valde armatis, dentibus usque ad 3–4 mm longis, in caudo dense congestibus multo minoribus ca. 1 mm longis; pagina utrinque valde reticulato-tessellata; costa basi dentibus retrorsis usque ad 5 mm longis, 1–2 cm sese separatis, dispositis. Inflorescentia terminalis, foemineo solitario, cephalio subgloboso, ca. 7 × 5 cm, e ca. 80 ad 90 drupis composito, pedunculato; drupis uniloculatis, 15–18 × 6–9 mm vel usque ad 22 × 13 mm, 5- vel 6-angulatis, apice subtruncato-subdepressa pyra-

midato, stylo 1- vel 2-cornuto, ca. $3-5 \times 4-6$ mm, cornis acicularibus 1-2 mm longis divergentibus vel valde divaricatis; endocarpio cupulato apice in acumine anguste conico breviter prolongato ca. 15-16 mm longo terminato. Cetera ignota.

TYPE. Sumatra, east coast, vale of Tangga, Asahan, May 1927, *H. H. Bartlett 8057* (holotype, US!).

ADDITIONAL SPECIMENS EXAMINED. **Indonesia.** SUMATRA: Asahan, Goerach Batoc, swampy places in forest, *Yates 1653* (UC!); west coast, Bukit Baloe Banting, 1100 m alt., *Jacobson 195* (BO!); Asahan, vic. of Taloen Djoring, Silo Maradja, Dec. 1927, *Rahmat si Toroes 39* (A!, MICH).

This is a very characteristic species known so far only from Sumatra.

The Jacobson collection included living plants (or seeds) that were subsequently grown in the Botanical Gardens, Bogor (now known as Kebun Raya, Indonesia). Specimens were later collected (in September 1932) from the cultivated plants. There is a whole fruit-head preserved in alcohol in the carpological collection there.

Pandanus regalis B. C. Stone, sp. nov.

FIGURES 9, 10.

A *Pandanus furcato* affini sed cephalio perelongato trigono-subcylindrico usque ad 100×25 cm, plurimis drupis composito; drupis ca. $38-40 \times 10$ mm, pileis pyramidato-rotundatis; stylo aceroso vel furcato; mesocarpio supra fibroso-medullosa, infra fibroso-subcarnoso; endocarpio osseo atrobrunneo-ferugineo apice acute pyramidato base truncato fere totam corpam drupae occupanti, ca. 27 mm longo, pariete ca. 2 mm crasso. Semen unicum.

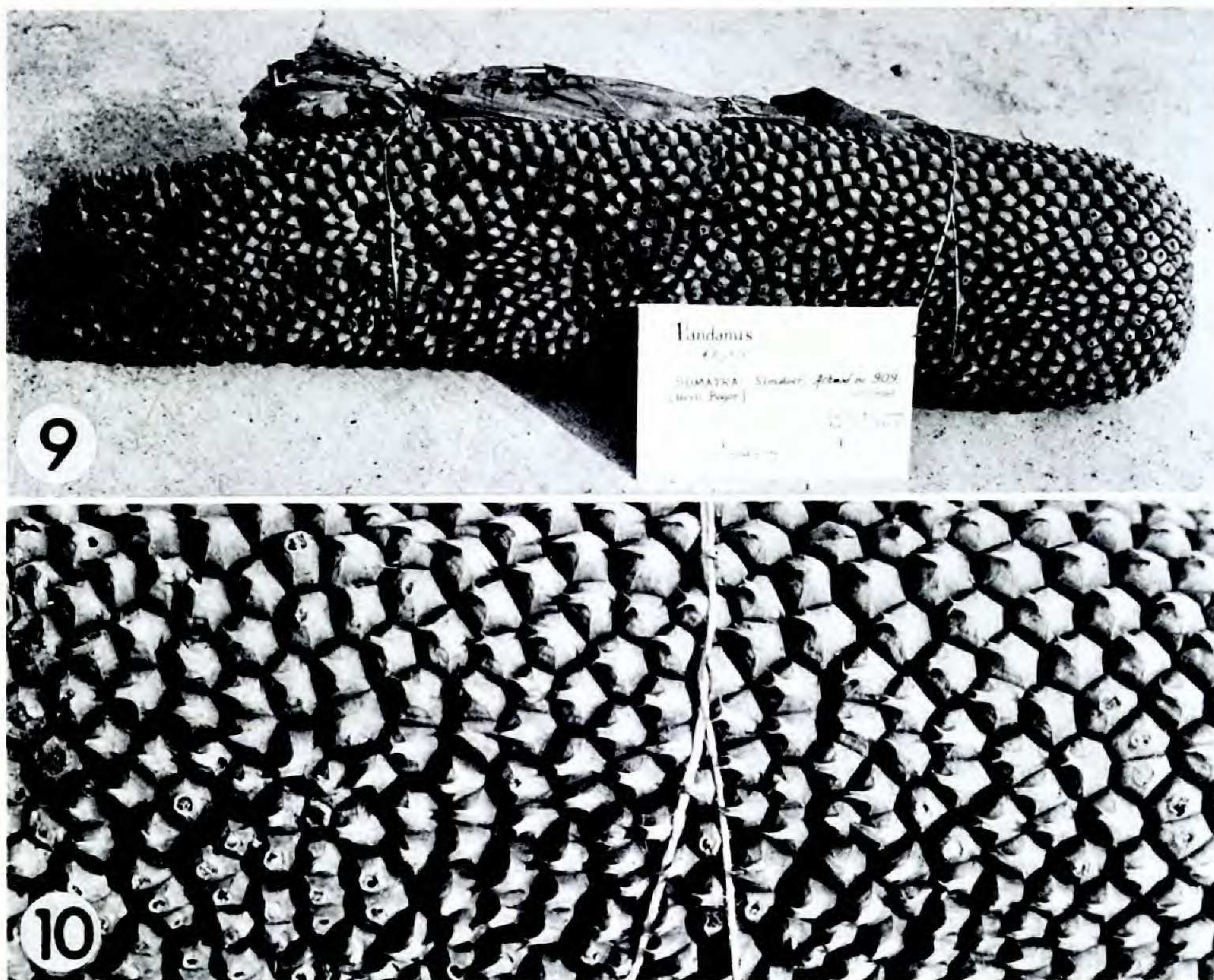
TYPE. Sumatra, Simaloer Island, Feb. 1919, *Achmad 909* (BO!).

No other material has been seen of what is certainly an imposing species. Although the leaf specimens in particular are only fragmentary, they give the impression of being from a very large plant. The middle portion of an adult leaf is 10.5 cm wide, with marginal prickles ca. 4 mm long and about 5-6 mm apart; another part of the leaf closer to the apex is nearly 8 cm wide, narrowing distally to 6.5 cm, with similar but closer clydoniform prickles. The fruit-head is longer than that of almost any other *Pandanus* species known to me, and the drupes are stocky and almost parallel sided.

Certainly this is a very distinctive plant. Nevertheless, it is clearly among the species closely related to *Pandanus furcatus* Roxb.

Pandanus tonkinensis B. C. Stone, sp. nov.

Frutex humilis, stipite usque ad 15 mm diametro; corona foliorum compacta. Folia ca. $50-90 \times 4$ cm, apice acuminato-caudata, basi leniter angustata, parte vaginanti maturitate cupreo-brunnea; marginibus in basi cum denticulis patentibus ca. 4 mm longis, 10-22 mm sese separatis, in medio cum denticulis 2-3 mm longis, usque ad 33 mm sese separatis, apicem versus denticulis ca. 1 mm longis, 2-5 (vel in caudo 1) mm sese separatis; costa media in basi denticulis retrorsis 4-5 mm longis, 10-15 (deinde ad 30) mm sese separatis,



FIGURES 9, 10. *Pandanus regalis* (from *Achmad 909*, type collection): 9, entire infructescence; 10, detail of same, showing drupe apices and forked styles.

in parte tertio medio inermi, apicem versus denticulis antrorsis ad eos in margine adjacentio similibus, in caudo extremo remotioribus; nervis longitudinalibus manifestis, cum venulis transversalibus reticulationibus tessellatis formantibus; lamina vulgo 48- ad 50-nervatis, nervis ca. 0.8-0.9 mm sese separatis. Inflorescentia terminalis, pedunculo ad 14 cm longis, apice 9 mm crasso, triquetro, bracteato; cephalium solitarium globosum maturitate ca. 55 × 50 mm, e ca. 70 drupis compositum; receptaculo ca. 15 × 10 mm; drupis obovoideis, ca. 25-27 × 10 mm, drupis basalibus exceptis (eis ca. 17 × 10-11 mm); pileus 3-5 mm altus, depresso pyramidatus, stylo centrale erecto vel antrorse deflecto rubro-brunneo nitido 4-5 mm longo subtereti vel compressi 1- vel 2-cornato instructo; furcibus stylosum vix 1 mm longis, acutis; mesocarpium superum medullosum, inferum fibroso-subcarnosum; endocarpium ca. 10 mm longum, apice in rostro subconico-centrale producto, 1-loculatum pariete ca. 1 mm crasso, osseo, atroferrugineo.

TYPE. [Vietnam], *Dac Lac* [Darlac] Province, SE of Poste du Lac, 1200 m alt., April 1921, *Poilane 32462* (holotype, p!).

ADDITIONAL SPECIMENS EXAMINED. **Vietnam.** HÀ SON BINH PROVINCE: Mt. Ba Vi, 1000 m alt., *Balansa 4165* (p!); Broyi, *Hayata 5211* (p!). NHA TRANG [PHU KHANH] PROVINCE: Nui-han-heo, *Poilane 4888* (p!). QUANG TRI [BINH TRI THIEN] PROVINCE: Col d'Ailao et Dent du Tigre, 1500 m alt., *Poilane 10403* (p!).

This taxon was segregated first by Martelli and was described, but only in

French, in H. Lecomte (Fl. Gén. Indo-Chine 6: 1063. 1937). No Latin diagnosis was ever published. Because *Pandanus nanofrutex* (described above) was among the specimens ascribed to *P. tonkinensis* by Martelli, it seems preferable to publish the latter as a new species here.

Pandanus tonkinensis is closely related to certain species of sect. RYKIA with small or even dwarf stature, small fruit-heads, leaves often noticeably contracted toward the base and usually abruptly acuminate-caudate at the apex, and drupes with usually forked styles. This group includes such species as *P. unguifer*, *P. bicornis*, *P. huyhnii*, and *P. nanofrutex*. These, and perhaps some others from Thailand, form a complex in which species distinctions are often obscure, perhaps mostly because of the very few and often inadequate collections made. For most, the staminate plants remain unknown. Basic to any improvement in our knowledge of this group, therefore, is a continued effort to obtain good collections supplemented by field observations and photographs.

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